Design for Reliability: Final Exam

SHORT ANSWER

1. **Define reliability.**
2. **What is the relationship between quality, reliablity and safety?**
3. **What is the difference between a population and a sample?**
4. **What are the general procedures for analyzing data?**
5. **What is the difference between the sample standard deviation and the population standard deviation?**
6. **What are the differences between discrete and continuous variables?**
7. **What is the normal distribution, the standard normal distribution?**
8. **What is the definition of an event and how does it relate to an experiment?**
9. **What is the difference between the mean, median & mode?**
10. **What is one measures of dispersion?**
11. **What is the difference between a one-tailed and two-tailed test?**
12. **Construct or describe the array of types of distributions verses the types of mathematical variations of the distributions (PDFs, CDFs, etc.). Explain the general mathematical processes used to calculate each function (e.g., how is a CDF derived from a PDF) and explain how each is used.**
13. **What is the difference between failure mode, failure cause, failure mechanism & failure stress?**
14. **How do failure rate, λ, MTBF and reliability relate to each other; under what conditions?**
15. **Draw and label each part of the bathtub curve. What does each represent and how is it used?**
16. **Explain the difference between a simple series & simple parallel RBD.**
17. **What are the main causes of electronic equipment failure?**
18. **What are the benefits and limitations of Mil-HDBK-217?**
19. **What are fault tolerance, fault avoidance and robust design?**
20. **Explain terminology: FMEA, CIL, REDUNDANCY, COMMON MODE FAILURE.**
21. **What is the difference between an FTA and FMEA?**
22. **When is each used?**
23. **What are the key components of a FTA? How is each used?**
24. **Why are problem reports important?**
25. **What are lessons learned and what is their aim?**
26. **Why is it beneficial to test?**
27. **What planning must be done before testing is started?**
28. **What is the basic approach methodology to reliability growth models?**
29. **What is the difference between Duane and AMSAA reliability growth models?**

30. **Explain what types of environments software operate in.**
31. **What are some of the types of hardware and software failures?**
32. **Why do accidents from software happen?**
33. **What types of problems are there predicting software reliability**
34. **Explain the system risks imposed by software.**
35. **Discuss the different types of software exist with respect to human interaction.**
36. **What are the objectives of reliability management?**
37. **What are the key reliability disciplines?**
38. **Describe what activities you would set upfor a reliability program to support a project?**
39. **What is human engineering and how does the human element affect reliability?**
40. **Explain how MTBF, MTTR and availability relate to each other.**
41. **How does maintainability analysis affect logistics?**
42. **What is supportability, how is the concept used?**
43. **What are the key data items necessary to determine maintainability requirements?**

PROBLEMS

(1) Thirty computer disk drives were tested and found to last and average of 1520 hours with a standard deviation of 1450 hours. Assuming the failures are normally distributed, how many units last longer than 1800 hours? How many fail in less than 1300 hours?

(2) Given the following set of failure data for a traveling wave tube amplifier (TWTA): Rank the data, calculate F(t) and determine the best fit distribution (exponential or weibull). Failure times equal 3200, 4900, 6500, 10700, 12800, 14200, 18500, 25500 hours.

(3) Given the following set of failure data for a mechanical actuator: Rank the data, calculate F(t) and determine the best fit distribution (exponential or weibull). Failure times equal 2450, 2600, 2810, 2930, 3050, 3140, 3260, 3280 cycles.

(4) Given the following set of failure data for a computer CRT: Rank the data, calculate F(t) and determine the best fit distribution (exponential or weibull). Failure times equal 1620, 2390, 3210, 5330, 6280, 7100, 8980, 12470 hours.

(5) Given the following set of failure data for a bearing life: Rank the data, calculate F(t) and determine the best fit distribution (exponential or weibull). Failure times equal 36900, 64500, 92700, 106500, 115000, 131500, 163100, 178000, 22300, 262400 cycles.

SYSTEM PROBLEM

(1) Given the following emergency aircraft backup power system:

Construct a reliability block diagram
Develop a plausible mission profile.
Discuss what environmental tests should be run.
Develop a reliability block diagram. Assume the following MTBF:

Solenoid Valve MTBF =	**5500 cycles**
Return hoses MTBF =	**10000 hours**
Supply Hoses MTBF =	**5000 hours**
Shuttle Valve MTBF =	**3000 cycles**
Hydraulic Motor MTBF =	**20 hours.**
Hydraulic Pump MTBF =	**12 hours**
Generator MTBF=	**100 hours**

Give estimates of additional parameters/assumptions as needed.
Allocate reliability assuming top level reliability should be 0.990 for mission duration = 60 min.
Perform a FMEA
Perform a FTA on the possibility of failure to deploy.
What would you suggest to improve the system?

Description: The aircraft power system consists of a propeller mounted on a hydraulic motor that is mounted on a hinge assemble. This unit deploys underneath the aircraft. The hydraulic power pressurizes lines and turns a motor generator assembly. A shuttle valve switches fluid flow from the regular power unit to the emergency power unit. The deployment consists of electrically actuating two servos, one that releases the unit and the second that operates the shuttle valve

Aircraft Emergency Power Unit